International Labour Organization

VISION ZERO FUND

Pesticide safety in action: Lessons from Myanmar

September 2021

International Labour Organization
Liaison Office in Myanmar

Pesticide safety in action: Lessons from Myanmar

September 2021

International Labour Organization
Liaison Office in Myanmar

First published 2021

ISBN: 9789220352045 (web PDF)

Information on ILO publications and digital products can be found at: www.ilo.org/publns.

▶ Foreword

Agrochemicals, such as pesticides and herbicides, are widely used in Myanmar, with both positive and negative effects on health, well-being, socio-economic aspects and the environment. Significant but still insufficient progress has been made internationally in chemicals management and regulations, and the situation for Myanmar is no different; there is some work to do on ensuring an effective regulatory framework is in place to guide agrochemical safety and is actively enforced.

Protecting workers from exposure to hazardous substances has always been a major concern for ILO. Several instruments exist, such as the Chemicals Convention 1990 (No. 170) and the Chemicals Recommendation 1990 (No. 177). ILO implements projects like Vision Zero Fund in order to support Member States in their adoption and implementation of these and other relevant International Labour Standards on chemical safety, actively promoting impactful activities among farmers and stakeholders in places like Shan state and advocating for the substitution of the most hazardous substances with safer alternatives.

I would like to thank the authors of the note, Dr Vasundhara Verma, independent consultant, and Mariana Infante Villarroel, Senior Technical Officer, ILO Vision Zero Fund Myanmar, with support from Khun Maung Toke, National Programme Coordinator, ILO Vision Zero Fund Myanmar. I would also like to thank Ockert Dupper, Andrew Christian and Halshka Graczyk (ILO's Labour Administration, Labour Inspection and Occupational Safety and Health (LABADMIN/OSH) Branch); colleagues from GIZ Myanmar; and all the national-level stakeholders of the Myanmar agriculture sector who shared their experience with the research team.

Donglin Li

Liaison Officer/Representative
ILO Liaison Office in Myanmar

Contents

List of acronyms

CPA	Certified Pesticide Applicator
CTUM	Confederation of Trade Unions Myanmar
DOA	Department of Agriculture
FAO	Food and Agriculture Organization of the United Nations
FFP	Filtering Facepiece Particle
FFS	Farmer Field School
GAP	Good Agricultural Practices
ILO	International Labour Organization
IPM	Integrated Pest Management
ITC	International Training Centre
OECD	Organisation for Economic Co-operation and Development
OP	Organophosphate
OPA	Outcomes and Practices Assessment
OSH	Occupational Safety and Health
PPE	Personal Protective Equipment
RPE	Respiratory Protective Equipment
TOT	Training of Trainers
VZF	Vision Zero Fund
WHO	World Health Organization

1.1 Introduction

Vision Zero Fund (VZF) has been implementing a project on occupational safety and health (OSH) in Myanmar since May 2017, working specifically within the garment and ginger value chains. The risks to farmers from the handling and use of agrochemicals within the ginger value chain are recognized as a significant OSH concern. As a result, in 2020, VZF commissioned a study to evaluate Myanmar's legislative and policy framework related to the management of agrochemicals throughout their lifecycle (from formulation and packaging to disposal).

Based on this study, this note focuses on specific risk mitigation strategies identified as key areas requiring further development in the Myanmar context. The note focuses in particular on strategies that can be implemented practically in the field by those working with farmers and input retailers. Separate notes address risk mitigation measures at a policy level. Aspects of pesticide management (such as advertising) require further fieldwork and exploration and are beyond the scope of this note.

Although the initial study investigated aspects relating to all agrochemicals, this note focuses on pesticides, as the study identified these as having the greatest impact on human health.

The note highlights lessons learnt from activities so far and references international examples to inform effective strategies to mitigate risks emanating from farmers' handling and use of pesticides. It can be used by national and international organizations engaged in promoting agrochemical safety in Myanmar.

The note highlights lessons learnt from activities so far and references international examples to inform effective strategies to mitigate risks emanating from farmers' handling and use of pesticides.

1.2 Framework of analysis

When looking at risk mitigation strategies in a workplace, it is helpful to consider a risk control hierarchy, to make it possible to prioritize interventions according to their effectiveness. In the case of pesticide use, it is also important to consider this hierarchy of controls in relation to the entire life cycle of the chemical. In this note, we discuss the hierarchy of controls for risk minimization in pesticide use. The note later focuses on four aspects of the pesticide life cycle that have been identified as key gaps within Myanmar's current practice and as areas where practical measures can be implemented in the field, namely:

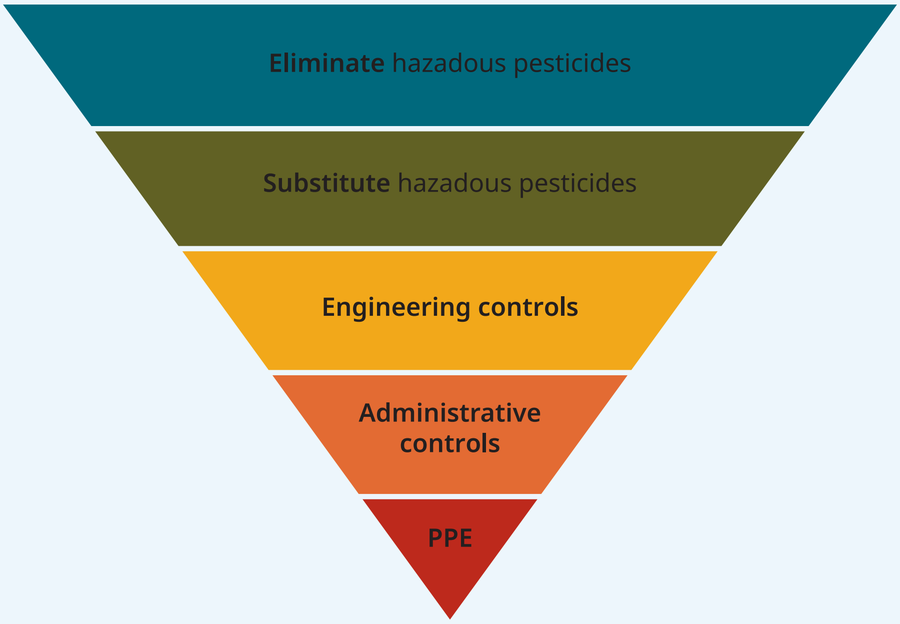
- Awareness training on reducing exposure to and safe handling and use of pesticides;
- Use of personal protective equipment (PPE) when applying pesticides;
- Safe storage of pesticides;
- Disposal of pesticides.

Lessons learnt from previous interventions and neighbouring countries have been used to inform future solutions, which have the aim of being sustainable, affordable and acceptable to farming communities in rural Myanmar.

1.3 Hierarchy of controls

ILO's guidance on OSH follows the principles of the hierarchy of controls for hazard prevention. This is a well-established approach for systematically identifying strategies to reduce risks at the workplace (Figure 1). The first approach is the complete elimination of the hazard. In the case of pesticides, this can be addressed through the adoption of organic farming methods and bans on hazardous chemicals. There is compelling evidence for a ban on hazardous pesticides; this is addressed in a separate note (Banning hazardous pesticides: Recommendations for Myanmar).

Figure 1: Hierarchy of controls in reducing exposure to hazardous agrochemicals



Source: ITC-ILO (2010) "Occupational Safety and Health Module". Building Modern and Effective Labour Inspection Systems Curriculum.

Where elimination is not possible, the next step is to substitute hazardous chemicals with safer practices. Good agricultural practices (GAP) can reduce exposure to chemical pesticides through the following of manual weeding strategies and other non-chemical pest control methods. Training and evidence-based guidance on pest management (e.g. Integrated Pest Management (IPM) can help reduce reliance on hazardous pesticides and assist farmers to use the least hazardous options where needed. Current VZF activities relating to this are discussed later in this note (see Table 1).

A robust risk assessment process at the pesticide registration stage is required to ensure that only pesticides with the lowest hazard for any given function are licensed for use. Consideration also needs to be given when granting registration to the accessibility of risk mitigation measures, such as the PPE required for a given pesticide in Myanmar (see discussion on PPE below).

Engineering and administrative controls should be used to minimize exposure to risks from the use of pesticides. Engineering controls refer to alterations at the design stage of equipment to isolate people from the hazard. These include the use of low-level induction bowls, application through vehicle-mounted or -trailed equipment and the mechanical rinsing of empty containers. While in countries such as Myanmar, where smallholder farmers have limited means, many of these measures may be unaffordable, there may exist simpler innovations that can reduce risk exposure – for example containers with a built-in measure to reduce spillage, drift-reducing nozzles and enlarging the filter opening in a tank to include a deep-set filter to avoid splashing of spraying liquid.[1] Affordable and effective engineering controls should be explored and agencies and the government encouraged to develop these.

Administrative controls focus on changing human behaviour to adopt safer methods when handling hazardous pesticides. Such measures can often be ineffective because of the realities of working conditions, such as production pressures, cost-saving, forgetfulness and apathy.[2] Nevertheless, they remain an important part of risk minimization in low-resource settings that do not have access to the protections offered by engineering controls such as mechanized farming. For example, the higher risk exposure from the use of manually operated knapsack sprayers – which are the commonly used delivery apparatus in Myanmar – can be reduced by directing spray to the side and downward while keeping the body upwind and away from the spray area. In this note, we look at lessons learnt from VZF activities to maximize the effectiveness of administrative controls.

The last and least effective approach – discussed later in this note – is the use of PPE when using hazardous substances.

[1] FAO (Food and Agricultural Organization of the UN) and WHO (World Health Organization) (2020) International Code of Conduct on Pesticide Management: Guidelines for Personal Protection When Handling and Applying Pesticide. Rome and Geneva: FAO and WHO.

[2] ITC-ILO (2010) "Occupational Safety and Health Module".

Table 1: Summary of activities carried out by VZF on awareness training, PPE use, storage and disposal of pesticides

VZF Phase 1 activities	Findings from Outcomes and Practices Assessment (OPA) of VZF's Phase 1 activities[3]
Awareness Training	
Myanmar GAP guidelines for ginger farmers, including core strategies to reduce exposure to risk, such as:[4,5,6] ▶ Reducing reliance on pesticides: IPM guidelines specific to commonly seen pests in ginger crops. Focus on hierarchy of controls in pest intervention commencing with prevention and biological interventions followed by guidance on specific pesticides to be used where necessary.[7] ▶ Administrative controls: guidelines on reducing exposure through safe practices in preparation and application of pesticides, such as planning the sprayer route, pre-harvest intervals and re-entry periods. Training of trainers (TOT) programme: ▶ Department of Agriculture (DOA) extension staff and partner organizations trained on raising awareness on agrochemical use/handling in 57 villages. ▶ A focus on safe input use and practical ways to minimise exposure. ▶ Training of input retailers. ▶ Capacity-building with input retailers and DOA for effective information-sharing on safe agrochemical use, including visual aids. Collaboration with Green Way app to disseminate guidance on OSH practices.	Overall knowledge of safe use and handling of agrochemicals improved from 51% to 91% in females and from 58% to 85% in males. 100% of farmers believed that OSH knowledge, own safety and PPE were important. >90% ensure safe route of application (i.e. not passing through spray/vapour drift). Drivers for positive change in behaviour: ▶ Peer-to peer information exchange identified as strongest influencer. ▶ Presence of a change leader from their own community. ▶ There was a readiness to engage in training and change behaviour if the interventions promised higher profit or productivity rather than safety alone. ▶ Witnessing peers benefiting from new practices was highly motivating. ▶ Input retailers identified as the other key source of information on agrochemical use. ▶ Input retailers expressed a readiness to engage in further training as they believed that maintaining customer safety and satisfaction would promote their business in the community.
PPE	
Awareness-raising as part of TOT programme on how and why to use PPE recommends use of full PPE for pesticides with a "Danger Poison" label. This includes goggles, respirator, long-sleeved shirt, sleeves over long rubber gloves, overalls, rubber boots and wide-brimmed hat.	▶ 100% of farmers wash clothes worn during pesticide application and keep these separate from other clothes. ▶ 63% wear some protective covering – mostly mask/hat/long boots/long-sleeved shirt.

[3] The OPA was commissioned in February 2020 to serve as a learning exercise to identify key internal and external factors influencing adoption of good practices of beneficiaries at the workplace level in Phase I of VZF activities.

[4] VZF (2019) "Good Harvest and Postharvest Practices: Ginger", Training Guide.

[5] VZF (2019) "Myanmar GAP: Ginger", Training Guide.

[6] VZF (2020) "OSH Training for Women and Men Ginger Farmers in Myanmar", Training Guide.

[7] East West Seed (n.d.) "Grow How Crop Guides", https://growhow.eastwestseed.com/bd/en/crop-guide

Storage	
Guidance on safe storage practices as part of the TOT programme, including: ▶ Designating a clearly identified, well-ventilated and securely closed space. ▶ Storing in the original containers with the label intact. ▶ Storing away from water, food, animal feed, seeds and other materials that could be contaminated. ▶ Storing liquid and solid formulations separately on a shelf below and away from dry substances. ▶ Keeping an inventory.	▶ 86% read the label for selection/mixing/applying/storing/disposal. Only 13% reported preparing pesticides according to instructions, suggesting poor understanding of label instructions. ▶ 98% keep agrochemicals away from food and drink and 100% keep them out of reach of children. ▶ No evidence on the level of compliance with all storage guidelines advised in the TOT programme.
Disposal	
Training on triple rinsing empty containers and their safe disposal at a community disposal site.	▶ Only 25% triple rinse containers before discarding (some do not have enough water). ▶ Community disposal site suggested but not set up.

2.1 Awareness training on reducing exposure to and safe handling and use of pesticides

2.1.1 Lessons learnt from VZF activities

Findings from the OPA show that, although training activities have led to greater awareness of the risks from exposure to agrochemicals, this has not always led to a change in behaviour to mitigate these risks.

Constraints to positive change in behaviour

A survey of input retailers in Shan state carried out by VZF in 2020 revealed a marked heterogeneity in the chemicals advised for use against the same pests across different retailers. This was particularly true for cabbage, cauliflower, potato and tomato.

Input retailers reported that their own knowledge on agrochemical use had come from Certified Pesticide Applicator (CPA) training and pesticide companies. Yet only three of the seven retailers interviewed had completed CPA training. Sale and use of illegally imported (cheaper) chemicals were also identified.

The OPA noted poor attendance by farmers for training that lasted more than one day. The OPA identified that, although 86 per cent of farmers reported reading the labels on pesticide bottles, only a minority followed the outlined instructions. Further exploration of the level of understanding and other contributors to this is needed to improve training and outcomes.

2.1.2 International evidence

Farmer field schools (FFS) focus on education, co-learning and experimental learning to empower farmers to better cope with the challenges faced (Box 1).[8,9] Its key principles are to have the farmer as the expert, the field as the learning place and extension staff as facilitators. Farmer trainers are trained using the TOT approach and can then train others as farmer trainers, thus further increasing the reach of the FFS and reducing the burden on extension staff. In Indonesia, 26,000 farmer trainers went on to train a further 100,000 new farmers.[10] The most effective farmer trainers are those selected from within the community they are training, and are literate. Training commonly takes the form of regular meetings of approximately 3.5 hours at regular intervals throughout the farming season at a time of day that is culturally acceptable.

▶ Box 1 Evidence for farmer field schools

A study by the Food and Agriculture Organization of the United Nations (FAO) following FFS engagement across Asia, Africa and South America pointed to an 81 per cent reduction in insecticide spray, a significant reduction in acetylcholinesterase blood levels (indicating a reduction in exposure to organophosphate (OP) insecticides), a 23 per cent increase in yield and a 41 per cent increase in profits in those trained at an FFS.

A review of multiple studies shows that the savings per farmer far outweigh the cost of training from this intervention, generating compelling evidence for the effectiveness of FFS in providing effective training and support for farmers and enabling a reduction in pesticide spray, appropriate use of pesticides and increases in yield and profit.

---

[8] Pretty, J. and Bharucha, Z.P. (2015) "Integrated Pest Management for Sustainable Intensification of Agriculture in Asia and Africa". Insects 6(1): 152–182.

[9] Van den Berg, H. (2004) "IPM Farmer Field Schools: A Synthesis of 25 Impact Evaluations".

[10] FAO (2000) "Integrated Pest Management: Report of the Evaluation Mission of IPM Projects in Bangladesh". Rome: FAO.

2.1.3 Recommendations for practitioners on future awareness training activities in Myanmar

Positive feedback and a readiness for further training were noted among farmers and input retailers.

Format of training: peer-to-peer and hands-on

The TOT approach used by VZF was seen as effective, with the greatest impact arising where the trainer was selected from within the community and seen as a positive role model. Training imparted by such agents was preferred to that given by DOA extension staff who were not from the community they were training and did not always speak the local language. This reflects international evidence on the effectiveness of FFS that use the same training model. Although farmers reported that presence of a local change agent was motivating, 85 per cent of those surveyed in the OPA did not feel they had such a role model in their village.

Further training using this TOT method could adopt the FFS format of several half-day sessions spread across strategic points within the farming season to maximize attendance and impact. A concerted effort should be made to engage the community in selecting change leaders for training. Empowering these trained individuals to become trainers themselves in subsequent seasons could help enhance the reach of the programme. Working collaboratively with external agencies operating within the agriculture sector, such as trade unions, the United Nations Industrial Development Organization and Myanmar Institute for Integrated Development could help identify change leaders across a larger area.

Hands-on training with practical demonstrations and visual aids was effective and should be continued. Resources allocated to training should allow for regular (monthly) follow-up in the field to reinforce messages for more effective results. Tools to measure changes in behaviour over time should be used to evaluate effectiveness of interventions and improve training quality.

Content of training modules

Interventions advised for risk mitigation should follow the principles of the hierarchy of controls (Box 2) and need to be rooted in improved productivity and/or increased profits. Both studies commissioned by VZF showed that farmers were willing to endure risks to their own safety and health from the use of hazardous chemicals if they believed it was necessary for protecting their crop. Training should clearly outline incentives for reduced reliance on pesticides and safer practices, namely:

- Financial reward from producing chemical-free products that allow access to better markets (e.g. organic, GAP) while also reducing adverse effects on human health and the environment;
- Cost-saving from reduced purchase of chemicals;
- Increased productivity from fewer chemical-related accidents and injuries.

▶ Box 2 Implementing the hierarchy of controls when planning training modules

- Greater emphasis on risk communication: understanding the rationale for reducing reliance on pesticides;
- Further promoting IPM strategies, which encourage the use of non-chemical-based measures as the first line for managing pests;
- Engineering controls: equipment such as manually operated knapsack sprayers to follow specifications published by the International Organization for Standardization. Other evidence-based risk-reducing equipment (e.g. drift reducing nozzles) to be promoted where available. Ensuring that equipment is well maintained and functioning correctly prior to use;
- Administrative controls: continued training on safety procedures when preparing, applying, storing and disposing of pesticides. A further focus on promoting understanding of label instructions and the importance of following safety measures.
- PPE: ensuring that users understand the importance of using PPE correctly to reduce exposure while also understanding its limitations (see below).

The cooperative model

One successful model for demonstrating the positive impact of reduced agrochemical use involves the formation of cooperatives facilitated by VZF among ginger farmers in Shan state. Of three cooperatives that were set up, one was particularly successful (Shwe Chin Sein) and a positive example for agencies and farmers to learn from (Box 3). The key driver for change in pesticide use in Shwe Gin Sein was the linkage with a large company (Snacks Mandalay), which required crops to meet safety standards with lower pesticide use and supplementation with organic inputs and gave a higher price for the crop. The financial incentive that drove this initial change empowered members to appreciate the feasibility of reduced pesticide use and its long-term benefit from higher profits and reduced health risks.

The Confederation of Trade Unions Myanmar (CTUM) is also promoting support to the creation of farmer groups to make the costs of accessing GAP markets (such as for testing) more affordable and to attract large buyers with bigger collective yields. Success of the Shwe Chin Sein group can be attributed to good leadership, delegation and organization, and especially to the successful link with a large processor supplying Western markets.

Further activities to organize farmer groups with effective leadership and female involvement are needed. Financial and technical support to increase access to GAP and organic markets and the establishment of internal control systems within cooperative groups would further enhance their success. The OPA revealed poor reach of training and cooperatives in the more remote parts of the townships; strategies are needed to reach these areas.

▶ Box 3 Shwe Chin Sein Coop Group in Lawkshawk township

85 members, 70% female

- Demonstrated strong leadership with female involvement;
- Clear delegation, training, communication, risk management and monitoring procedures;
- Linked to Snacks Mandalay Co. Ltd, which required adherence to specific OSH standards;
- Product rejection by Snacks Mandalay reduced from 10–15% in first year to <2% in second year;
- Positive engagement led to an increase in purchase by Snacks Mandalay from 3,000 viss of ginger in the first year to 32,000 viss of ginger and a promise for higher quantities to be purchased in 2020;
- Number of members increased from 35 to 85 over the course of 2 years;
- Success empowered the group to appreciate the personal benefits of adopting OSH and investing in this further. The group is currently working on:
  - o Promoting the use of PPE;
  - o Producing chemical-free products;
  - o Safer storage and disposal of agrochemicals.

Input retailer training

The completion of CPA training by all members of staff in input retail shops – not just the owner – needs to be ensured. In addition, greater access to evidence-based guidelines on pest management for each crop is needed to avoid the heterogeneity seen in recommended pesticides across different retailers. Pesticide companies were reported as a significant source of knowledge for input retailers; this needs to be monitored to ensure advice is based on effectiveness and harm minimization.

Input retailers expressed the need for quick reference aids such as a mobile app, leaflets and posters to enable the dissemination of information to farmers. Although some pesticide companies have development mobile apps to guide pesticide use, a non-biased evidence-based platform is desirable.

2.2 Use of personal protective equipment

PPE is defined as any clothes, materials or devices that protect the user against the risk of accidents or of adverse effects on health. It can include items such as safety helmets, gloves, eye protection, high-visibility clothing, safety footwear, safety harnesses and respiratory protective equipment (RPE).[11,12] It is the last line of defence and least effective, and should be used as supplementary protection against exposure where safety cannot be ensured by means of other means in the hierarchy of controls (Figure 1).[13] It is vital to understand that appropriate PPE can reduce exposure but does not prevent it.

PPE may reduce exposure through the skin (dermal), mouth (oral), nose, lungs and eyes. Dermal (particularly through the hands) and inhaled are the most common routes of exposure to pesticides and this risk is heightened during mixing, loading and application of pesticides. Exposure through inhalation is particularly high when handling volatile chemicals, during indoor spraying and where masks are used incorrectly.

It is vital to understand that appropriate PPE can reduce exposure but does not prevent it.

2.2.1 Types of personal protective equipment

Table 2 outlines the different types of PPE and the level of protection they provide for the area they cover. Effectiveness of PPE is, however, dependent on the equipment fitting the user and being handled correctly. Incorrect use may increase exposure rather than reduce it; for example, wet cotton clothing may increase dermal absorption and should therefore be changed prior to continuing pesticide handling.

Types 3 and 4 chemical-resistant coveralls are not breathable and can therefore get unbearably hot in a tropical climate. Types 5 and 6 are better tolerated but are not recommended against liquid chemicals, which are the most commonly used preparations in Myanmar.

[11] ILO (n.d.) “Occupational Safety and Health: A Guide for Labour Inspectors and Other Stakeholders”. https://www.ilo.org/global/topics/labour-administration-inspection/resources-library/publications/guide-for-labour-inspectors/lang--en/index.htm

[12] WHO and FAO (2019) Global Situation of Pesticide Management in Agriculture and Public Health. Geneva and Rome: WHO and FAO.

[13] ILO (2011) “Safety and Health in Agriculture”. Code of Practice. Geneva: ILO.

▶ Table 2: Types of PPE and their effectiveness[14]

Type of PPE	Area protected	Level of protection [% reduction of pesticide absorption (type of absorption reduced)]
Cotton coveralls covering arms, body and legs	Body	90% (dermal)
Protective chemical-resistant coveralls*	Body	95% (dermal)
Gloves	Hands	90% (dermal) from liquid preparations 95% (dermal) from liquid preparations
Hood	Head	50% (dermal)
Hood and visor	Head	95% (dermal)
Filtering facepiece particle (FFP) 1 mask	Head	20% (dermal) 75% (inhalation)
FFP 2 mask	Head	Import permitted until December 2018, banned from 1 January 2020 Not allowed for registration

*Chemical-resistant clothing is categorized into six types according to the level of protection it provides.

Type 1: fully enclosed and gas-tight.
Type 2: gas-tight for use with airline breathing apparatus.
Type 3: liquid-proof, typically used when handling WHO class Ia, Ib or II liquid pesticide preparations.
Type 4: splash and spray-resistant, typically used when handling WHO class III and U liquid pesticide preparations and solid pesticides that are irritants or corrosive.
Type 5: particulate-resistant spray-tight (limited), appropriate for handling most solid pesticides.
Type 6: limited protection against splashes and particles, used when there is no direct contact with pesticides.

2.2.2 Types of personal protective equipment

Focus group discussions with ginger farmers and a survey of input retailers revealed that full PPE was considered expensive and impractical for the climate in Shan state. Most farmers reported wearing some degree of full-sleeve shirts, gloves, face covering and hats; however, specifics on the type of mask or gloves worn are not available. Inspections carried out by DOA extension staff revealed poor compliance with PPE. Most input retailers gave some advice on the use of PPE but only stocked N95 masks, goggles and rubber gloves as additional PPE. Overall, there appears to be low availability and uptake of the PPE recommended in VZF training, and further fieldwork is needed to gain a better understanding of current practices and the key constraints to high uptake.

[14] FAO and WHO (2020) International Code of Conduct on Pesticide Management.

2.2.3 International evidence

The International Code of Conduct on Pesticide Management recommends use of PPE as appropriate to the prevailing climate conditions and affordability for the community.[15] Pesticides whose handling and application require use of PPE that is uncomfortable, expensive or not readily available should be avoided. The role of PPE in reducing exposure has to be balanced with its practicality in hot climates such as that in Myanmar as well as its affordability. Use of advanced PPE can have detrimental OSH consequences as a result of increased sweating, leading to increased dermal absorption of substances, heat stress, dehydration and being more prone to accidents if under heat stress.[16] All these aspects can lead to lower acceptance of PPE in tropical climates.

A systematic review looking at evidence on the uptake of PPE usage among farmers across the world shows that wearing general work clothes that provide body coverage (66 per cent wore long-sleeved shirts, 71.1 per cent wore long trousers, 47.3 per cent wore hats) is more common than the usage of advanced PPE (such as waterproof aprons – 23.8 per cent, respirators – 13.5 per cent)[17]. Uptake of PPE is worse in low- and middle-income countries, although another review paper highlights that actual wearing of PPE is well below stipulated recommendations in Organisation for Economic Co-operation and Development (OECD) countries as well.[18] The evidence highlights the reality of low uptake of PPE, especially in low- and middle-income countries across the world, and needs to be considered when devising appropriate measures for harm minimization from pesticide use.

The Code of Conduct recognizes the limitations of using PPE such as Type 3 or 4 chemical-resistant overalls in tropical climates and therefore advises the following:

- Scrutinize the PPE at the pesticide registration stage, with serious consideration to refusing registration where the required PPE is unrealistic. Companies applying for registration should have to outline clearly the PPE required and its availability in the market. Input retailers should in turn provide the PPE required for the products they sell.
- Ensure clear risk communication to input retailers and users on the use of PPE, donning and doffing PPE and its maintenance and disposal.
- Recommend that the use of PPE come after all options for elimination, substitution, engineering and administrative controls have been considered. At the very least, pesticide users should wear long-sleeved shirts, long trousers, boots, socks, chemical-resistant gloves and a hood or water-resistant hat even where the label does not outline the need for any PPE. Where formal PPE is recommended for a chemical, FAO recommends a minimum acceptable level of protection as outlined in Annex A. The guidance stresses the importance of using chemical-resistant gloves, as hands are the most exposed area. At times of greatest exposure risk, such as during preparation of spraying liquid and management of empty containers, FAO advises the added use of rubber or PVC aprons that cover the body from neck to below the knees. Wearing a hood or hat and a transparent plastic visor is believed to give comprehensive protection to the face and eyes and can be well tolerated in hot climates.

[15] Ibid.

[16] Ibid.

[17] Sapbamrer, R. and Thammachai, A. (2020) "Factors Affecting Use of Personal Protective Equipment and Pesti cide Safety Practices: A Systematic Review". Environmental Research: 109444.

[18] Garrigou, A. et al. (2020) "Critical Review of the Role of PPE in the Prevention of Risks Related to Agricultural Pesticide Use". Safety Science 123: 104527.

2.2.4 Recommendations for future training on personal protective equipment use

It is vital to ensure that training highlights PPE as the last and least effective line of defence against pesticide risk. Moreover, its use reduces but does not prevent pesticide absorption and its effectiveness in doing so is dependent on using the correct type and fitting of equipment. More effective risk mitigation strategies guided by the hierarchy of controls should be prioritised over PPE.

Robust systems need to be in place during the pesticide registration process to enable refusal of the registration of pesticides that require unrealistic PPE (e.g. WHO classification Ia, Ib and II liquid preparation pesticides, which require Type 3 chemical-resistant clothing – see Table 2). As part of the application for registration, pesticide companies should be required to outline the PPE required, keeping in mind the agricultural practices of the farmers in Myanmar. Where possible, approved pesticides should be required to change formulation to the least hazardous type – for example solid preparations.

Greater market research into the availability and cost of Types 3 and 4 chemical-resistant coveralls, chemical-resistant gloves, FFP masks, visors and boots is needed. Further fieldwork is also needed to explore the drivers of and constraints to the uptake of the minimum necessary PPE to better inform training on safe handling of pesticides. The government also needs to monitor the availability of appropriate PPE, including its quality, affordability and appropriateness for the climate. Input retailers should be required to advise on and sell the PPE required for the products they sell.

Exploration of the uptake of PPE in other tropical countries and the role of government and industry in providing the equipment could be useful.

Choice of personal protective equipment

At the very least, pesticide users should wear long-sleeved shirts, long trousers, boots, socks, chemical-resistant gloves and a hood or water-resistant hat even where the label does not outline a need for any PPE. Annex A outlines the minimum acceptable PPE required when handling a pesticide that requires the use of PPE.

The applicator should aim to read and understand PPE recommendations for the chemical being used and should not "over protect" the body and risk overheating.

Training on the handling of personal protective equipment

Training should continue to be provided on the risks of pesticide exposure, highest risk areas and activities and the role and limitations of PPE. Practical sessions should provide guidance on donning and doffing PPE, checking the correct fit of equipment such as FFP masks and washing and disposing of PPE safely.

PPE and other equipment should be checked to ensure they are adequate prior to pesticides being handled. The area to be treated should be cleared of other people and hazards and a buffer zone created, as well as maintenance of re-entry intervals.[19] Application of pesticides should be avoided during the hottest part of the day to avoid overheating from the use of PPE. The handler should keep well hydrated and take adequate rest.

A water source should be available where pesticides are prepared, and this should be away from other people and dwellings. PPE should be cleaned in this area and stored in a locked facility separate from other clothing and pesticides. Reusable equipment such as chemical-resistant gloves and boots should be washed before being removed.

First aid training and equipment should be provided to deal with acute exposure.

Choice of pesticide handler

Evidence suggests greater uptake of PPE among males, those with higher literacy and those who have undergone training on following safety precautions in the use of PPE. Handlers should be in good health and should not be pregnant or breastfeeding women.

[19] VZF (2019) "Good Harvest and Postharvest Practices: Ginger", Training Guide

2.3 Safe storage of agrochemicals

2.3.1 Lessons learnt from VZF activities

The OPA revealed that the majority of farmers stored agrochemicals away from food and drink and the reach of children. However, the storage facility used was not mentioned. In addition, further exploration of compliance with storage advice given during training (see Table 1) is needed.

2.3.2 International evidence

There is limited published data on the effectiveness of storage interventions trialled in other countries. Findings from two studies, from India and Sri Lanka, give inconclusive evidence and are summarized in Table 3. Guidelines from ILO and FAO advise that a pesticide should be kept:[20,21]

- In a locked facility away from food and drink, children and livestock;
- In its originally labelled container with the minimum required amount purchased;
- In a designated storage facility that should not be in an area with high groundwater levels and should be away from water sources, dwellings, schools, hospitals, etc. The facility should be well lit, away from direct sunlight and ventilated, with smooth concrete floors and ample space for storage and management of pesticides. The floor area should be slightly raised at the edges and there should be a bund around the whole area to contain spillages. There should be a designated space for storing empty containers and handwashing;
- Upright and off-the-floor, with regular checks held for leaks, tears, rust and loose lids;
- With sand and a brush nearby to absorb and clean any spillages. Dry powder products should be kept above liquid products and products should be kept in a way that eliminates cross-contamination (e.g. herbicides separate from insecticides).

[20] VZF (2019) "Myanmar GAP: Ginger". Training Guide

[21] FAO (1996) "Pesticide Storage and Stock Control Manual". FAO Pesticide Disposal Series 3. Rome: FAO.

[22] Pearson, M. et al. (2017) "Effectiveness of Household Lockable Pesticide Storage to Reduce Pesticide Self-Poisoning in Rural Asia: A Community-Based, Cluster-Randomised Controlled Trial". Lancet 390(10105): 1863–1872.

[23] Vijayakumar, L. et al. (2013) "A Central Storage Facility to Reduce Pesticide Suicides: A Feasibility Study from India". BMC Public Health 13(1): 1–10.

▶ Table 3: Findings from community-based studies looking at the effectiveness of safe storage interventions for storing pesticides[22,23]

Country	Sri Lanka	South India
Study design	Community-based cluster-randomized trial	Community-based randomized-control trial-feasibility study
Sample size	53,382 households	1,879 households
Intervention	Lockable storage box within the house-hold for storing pesticides	Central storage facility close to farming land selected by village leaders
Primary outcome	Incidence of self-poisoning	Incidence of self-poisoning
Findings	▶ No change in incidence of self-poisoning ▶ Some concerns of increased use of pesticides for deliberate self-harm owing to closer proximity in a locked container at home rather than in the field	▶ Significant reduction in attempted and completed pesticide suicide ▶ Attempts that did occur were by household not utilizing the central storage facility ▶ 35% did not use the facility owing to distance from their field

2.3.3 Recommendations for safe storage

Further exploration of the space where agrochemicals are currently being stored is needed. The acceptability of setting up a shared storage space for farming equipment and chemicals close to the field should be explored. Any such facility should be created in consultation with the community to ensure a practical location, size and design. Such an intervention would also require assessment of the technical and financial assistance needed. Strategies for means reduction for deliberate self-harm should be considered, given that evidence shows this to be a concern in Myanmar. These strategies can be included during trainings on safe storage by, for example, discouraging storage of pesticides in a facility within the house, given the evidence from Sri Lanka.

[22] Pearson, M. et al. (2017) "Effectiveness of Household Lockable Pesticide Storage to Reduce Pesticide Self-Poisoning in Rural Asia: A Community-Based, Cluster-Randomised Controlled Trial". Lancet 390(10105): 1863–1872.

[23] Vijayakumar, L. et al. (2013) "A Central Storage Facility to Reduce Pesticide Suicides: A Feasibility Study from India". BMC Public Health 13(1): 1–10.

2.4 Disposal of agrochemicals

2.4.1 Lessons learnt

Inspection by DOA staff has shown poor compliance with disposal practices taught through training. The OPA also reported that, although a community disposal site had been recommended, this had not been implemented in the community. In addition, some farmers reported being unable to triple rinse empty containers owing to a lack of water.

Further investigation into current practices and drivers and constraints for positive change is needed to inform specific interventions.

2.4.2 International evidence

Triple rinsing empty pesticide containers with water is believed to remove over 99.9 per cent of pesticide residue from the container, allowing it to then be classified as non-hazardous waste. The International Code of Conduct on Pesticide Management therefore advises that this be carried out by farmers immediately after the pesticide bottle is emptied, as this allows for the rinsed fluid to be added to the knapsack tank, thereby using up every last drop of the substance and making it less hazardous for the environment.

A sound container management scheme should be developed within the country. The International Code of Conduct on Pesticide Management advises against the burning (owing to the release of persistent toxic emissions) and burying (owing to the use of precious land and the tendency of empty containers to gradually resurface) of empty containers by farmers.

Several effective container management schemes have now been piloted around the world (Table 4). Such schemes have usually been piloted as voluntary schemes and later enshrined in legislation and have required the involvement of the manufacturers and distributors of agrochemicals. Success from these case examples requires some preliminary investigation into:

- Types and quantities of containers generated by the community;
- Geographical distribution;
- Evaluation of the agrochemical supply chain – to identify strategic points for the use of reverse logistics for container collection;
- Cycles and peaks in the farming season when collection is needed;
- Consideration of the route for payment of the scheme;
- Multi-stakeholder involvement for the investigative, design and implementation process;
- Identification of a recycling and disposal agency capable of handling the pre-treatment, segregation, recycling and sound disposal of empty containers.

Reverse logistics, whereby manufacturers and distributors have ultimate responsibility for the collection and sound management of empty containers, have been piloted successfully in several countries. This can represent a more convenient method for farmers, who can return empty containers at the same time as they purchase new containers. In addition, using the same transport methods on their return can lead to up to 45 per cent cost saving and reduce the impact from additional traffic and emissions. Such a process would require monitoring of the waste management agencies to ensure they meet appropriate standards for the sound management of waste and can also require incentivising farmers to return empty containers.

[24] CropLife International (n.d.) "Triple Rinse". https://croplife.org/crop-protection/stewardship/container-management/triple-rinse/#:~:text=Triple%20rinsing%20 empty%20 containers%20is,or%20more%20of%20product%20residue.&text=Containers%20that%20are%20rinsed%20as,non%2Dhazardous %20as%20described%20here

[25] FAO and WHO (2008) International Code of Conduct on the Distribution and Use of Pesticides: Guidelines on Managment Options for Empty Pesticide Containers. Rome and Geneva: FAO and WHO.

Table 4: Examples of container management schemes[26,27,28]

Brazil	
Campo Limpo system: ▶ Reverse logistics strategy with a focus on shared responsibility ▶ Voluntary pilot scheme now enshrined in law with farmer responsibility for triple rinsing and manufacturer and distributor responsibility for training, collection and sound management of empty containers	▶ 94% of primary plastic packaging and 80% of total empty crop protection packaging disposed of in an environmentally sound manner. ▶ 95% properly triple rinsed and recycled into raw material for other products. Remaining 5% sent to accredited incinerators.
Mauritius	
▶ Pilot targeted 100 farmers grouped in cooperatives ▶ Awareness-raising activities and training on triple rinsing ▶ Design and construction of empty container collection cages placed in strategic locations near fields ▶ Identification of recycling agency ▶ Leaders from within community selected to train ▶ Monitoring of process	▶ Increase in disposed empty containers from 154.1 kg to 312.8 kg ▶ Gradual increase in triple rinsing ▶ 46% of total estimated containers collected in the cages ▶ 75.6% appeared to be triple rinsed correctly ▶ Greater efficacy upon incentivizing the most effective leader and farmer with an agricultural sprayer prize ▶ Challenge of waste aside from empty pesticide packaging being deposited in the collection cages and extra resources needed to manage this
Guatemala	
Campo Limpo system: ▶ Triple rinsing and depositing in collection cages ▶ Funded through import tax on agricultural products	▶ 70 tonnes collected in 2000 and increased to 230 (of total 350 tonnes sold) in 2008 ▶ Scheme taken onboard in neighbouring El Salvador, Honduras and Nicaragua
Chile	
▶ Training on triple rinsing ▶ Collection at specific sites organized by pesticide dealers and distributors ▶ Containers shipped to government-approved cement factories, recycling plants or landfill facilities.	▶ Started with 4 collection centres in 2001 and increased to 27 fixed centres and 64 mobile collection points in 2021

[26] National Institute for Processing Empty Packages (n.d.) “Campo Limpo System”. https://www.inpev.org.br/en/inpev/

[27] Crop Life Mauritius (2017) “Empty Pesticides Container Management – Pilot Project”.

[28] FAO and WHO (2008) International Code of Conduct on the Distribution and Use of Pesticides.

2.4.3 Recommendations for sound disposal of hazardous waste

Further exploration of current practice and drivers for positive change is needed to inform effective strategies for Myanmar. Integrating sound disposal procedures into MyanGAP guidelines – the Myanmar adaptation of GAP – should be considered.

Triple rinsing

Further regular training, particularly in the field with demonstrations, should be carried out. Posters and other visual aids, such as videos on social media demonstrating the correct procedure, should be used. Setting up a water source close to a storage facility where pesticide preparations are made could improve farmer ability to triple rinse empty containers.

Exposure risk from triple rinsing in the absence of proper PPE should be considered and practical training delivered to minimize risk.

Waste management system

Consideration should be given to collaborating with agrochemical manufacturers, distributors and retailers to explore their role in developing a waste recycling and disposal system. Exploration of possible funding sources to pilot a waste collection service is necessary. Such a pilot would need to undertake preliminary fact-finding activities as outlined above.

A long-term vision to hold manufacturers responsible for making recyclable containers and managing waste through a reverse logistics principle should be considered, with safeguards in place to protect the price of pesticide products (so that manufacturers do not seek to pay for waste management through an increase in product prices).

References

- Crop Life Mauritius (2017) "Empty Pesticides Container Management – Pilot Project".
- CropLife International (n.d.) "Triple Rinse". https://croplife.org/crop-protection/stewardship/container-management/triple-rinse/#:~:text=Triple%20rinsing%20empty%20containers%20is,or%20more%20of%20product%20residue.&text=Containers%20that%20are%20rinsed%20as,non%2Dhazardous%20as%20described%20here
- East West Seed (n.d.) "Grow How Crop Guides", https://growhow.eastwestseed.com/bd/en/crop-guide
- FAO (Food and Agriculture Organization of the United Nations) (1996) "Pesticide Storage and Stock Control Manual". FAO Pesticide Disposal Series 3. Rome: FAO.
- FAO (2000) "Integrated Pest Management: Report of the Evaluation Mission of IPM Projects in Bangladesh". Rome: FAO.
- FAO (Food and Agriculture Organization of the United Nations) and WHO (World Health Organization) (2008) International Code of Conduct on the Distribution and Use of Pesticides: Guidelines on Managment Options for Empty Pesticide Containers. Rome and Geneva: FAO and WHO.
- Garrigou, A., Laurent, C., Berthet, A., Colosio, C. et al. (2020) "Critical Review of the Role of PPE in the Prevention of Risks Related to Agricultural Pesticide Use". Safety Science 123: 104527.
- ILO (International Labour Organization) (2011) "Safety and Health in Agriculture". Code of Practice. Geneva: ILO.
- ILO (n.d.) "Occupational Safety and Health: A Guide for Labour Inspectors and Other Stakeholders". https://www.ilo.org/global/topics/labour-administration-inspection/resources-library/publications/guide-for-labour-inspectors/lang--en/index.htm
- ITC (International Training Centre)-ILO (International Labour Organization) (2010) "Occupational Safety and Health Module". Building Modern and Effective Labour Inspection Systems Curriculum.
- National Institute for Processing Empty Packages (n.d.) "Campo Limpo System". https://www.inpev.org.br/en/inpev/
- Pearson, M., Metcalfe, C., Jayamanne, S., Gunnell, D. et al. (2017) "Effectiveness of Household Lockable Pesticide Storage to Reduce Pesticide Self-Poisoning in Rural Asia: A Community-Based, Cluster-Randomised Controlled Trial". Lancet 390(10105): 1863–1872.
- Pretty, J. and Bharucha, Z.P. (2015) "Integrated Pest Management for Sustainable Intensification of Agriculture in Asia and Africa". Insects 6(1): 152–182.
- Sapbamrer, R. and Thammachai, A. (2020) "Factors Affecting Use of Personal Protective Equipment and Pesticide Safety Practices: A Systematic Review". Environmental Research: 109444.

- Van den Berg, H. (2004) “IPM Farmer Field Schools: A Synthesis of 25 Impact Evaluations”.
- Vijayakumar, L., Jeyaseelan, L., Kumar, S., Mohanraj, R. et al. (2013) “A Central Storage Facility to Reduce Pesticide Suicides: A Feasibility Study from India”. BMC Public Health 13(1): 1–10.
- VZF (2019) “Myanmar GAP: Ginger”, Training Guide.
- VZF (2019) “Good Harvest and Postharvest Practices: Ginger”, Training Guide.
- VZF (2020) “OSH Training for Women and Men Ginger Farmers in Myanmar”, Training Guide.
- WHO (World Health Organization) and FAO (Food and Agriculture Organization of the United Nations) (2019) Global Situation of Pesticide Management in Agriculture and Public Health. Geneva and Rome: WHO and FAO.

▶ Annex A: Personal protective equipment for applying agricultural pesticides[29]

▶ The suggested basic minimum requirements are shown in the table below.

Always read the label and follow the manufacturers' instructions for each pesticide.

Activity	Coveralls and boots	Gloves	Face shield or goggles	Apron	Hood or hat	RPE*	Ear Protection	Notes
Handling unopened packs	✓	✓	O					
Mixing and filling spray tank (unclassified pesticides)	✓	✓	✓	O	✓			1
Mixing and filling spray tank (harmful and irritating pesticides)	✓	✓	✓	✓	✓			1
Mixing and filling spray tank (WHO class I and class II pesticides)	✓	✓	✓	✓	✓	✓		2
Spraying downward with hand-held lance	✓	✓			✓			3
Spraying upward with hand-held lance	✓	✓	✓		✓	O		4
Operator in cab	✓							5
Tractor but no cab	✓	✓			✓			
Mist blowers	✓	✓	✓		✓		✓	4
Fogging in greenhouses and stores	✓	✓	✓		✓	✓	✓	4
Applying granules	✓	✓						2,6
Applying treated seed	✓	✓				O		3
Changing nozzles	✓	✓		O				
Cleaning sprayers	✓	✓	O	✓				
Cleaning PPE and RPE	✓	✓	O					
Disposing of waste	✓	✓						

*RPE is used primarily when the majority of spray droplets are <30 µm. It may be required in other circumstances, such as during use of dusts, especially in a confined space.

Notes:

1. Use induction hopper on tractor-mounted or larger sprayers or equivalent.
2. Use closed transfer system, if available, especially for highly toxic insecticides.
3. Hat required when walking in fields to protect from sunlight.
4. Endeavour to remain upwind of spray.
5. A cab should have a well-filtered air ventilation system, and cab windows should be closed.
6. Avoid applying dusts, and ensure that granules are not fractured into smaller dust particles by setting the applicator properly.

O. Optional

[29] FAO and WHO (2020) International Code of Conduct on Pesticide Management.

International Labour Organization
Labour Administration, Labour Inspection
and Occupational Safety and Health Branch
(LABADMIN/OSH)

Route des Morillons 4
CH-1211 Geneva 22
Switzerland

ilo.org/vzf
vzf@ilo.org

Current and Past Donors

This project is funded by the European Union

Vision Zero Fund is part of Safety & Health for All, an ILO flagship programme building a culture of safe, healthy work.